An Investigation of the Oral Health Status of a Group of Libyan Children with Congenital Heart Disease at Benghazi Children Hospital

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ABSTRACT

Aim: The aim of this study was to investigate the oral health of a group of children with congenital heart disease in Benghazi children’s hospital attending (out-patient) or admitted (in-patient). Subjects and Methods: Seventy children with congenital heart disease (mean age of 7.2) were included in the study and subdivided into 3 age groups (29 children were <6 years old, 29 in mixed dentition 6-12 years and 12 were >12 years old. Both extent and severity of gingivitis were assessed in the incisor area of the maxilla and the incisor and canine area of the mandible using the extent of gingivitis (EG) and gingivitis severity (GS) indices. The individual gingival units: papillae (P); margins (M) and attached gingivae (A) were assessed for the presence of inflammation based on visual examinations. The extent of inflammation was measured by scoring the color change of the most severe gingival unit in upper and lower index teeth. Caries experience was assessed using dmft for deciduous teeth and DMFT for permanent teeth. Results: Different degrees of gingival inflammation EG&GS were present in 94.3% of children, which was predominantly moderate gingivitis (GS2, 59%) and was not age related (p>0.05). Untreated dental caries was present in 49% children and was age related (p≤0.001). Total DMFT (mean ± Std.) was 0.271 ± 0.75 while dmft was 2.0 ± 3.4 and was significantly increased with age (p<0.001). Conclusion: There has been more untreated caries and pronounced gingival inflammation of various degrees due to lack of proper dental care that prompts the importance of eliminating the sources of infection from the oral cavity.

Keywords: Oral Health, Children, Congenital Heart Disease, Benghazi.

1. INTRODUCTION

Congenital heart disease (CHD) is one of the most frequently occurring developmental abnormalities in children (1). It affects about 8-13.7 per 1000 live births (2,3) and accounts for about 90-95% of all established heart disease in children (4). Increasing numbers of children affected by complex CHD live longer owing to advances in medical diagnosis and early palliative surgery (5,6,7). CHD is the single most common underlying condition in the etiology of infective endocarditis (6,7). Dental procedures have often been accounted responsible for cases of infective endocarditis. However, poor oral health may actually precipitate more cases of infective endocarditis than do dental procedures (8). Dental procedures in the presence of marked gum disease may induce more bacteremia than those with the clean mouth (9,10). The less the degree of gingivitis the less likely is the frequency and severity of transient bacteremia (11). Most cases of post-surgical endocarditis had their etiology related to organisms in the oral cavity (12); therefore periodontal infection and dental decay should be diagnosed and eliminated before any open heart surgery to minimize
the risk of IE (13).

The aim of this study was to investigate the oral health status of a group of children with congenital heart disease attending as an outpatient or admitted to a major children’s hospital for cardiac investigations and treatment. We also aim to make this study as a baseline reference for any future investigation of such group of medically compromised children.

2. METHODS

Ethical approval was obtained from The Cardiology Department Group in Children’s Hospital, Benghazi/ Libya.

Selection of the subjects

Each child with congenital heart disease was examined in the ward as an in-patient or during routine follow-up as an outpatient. During the examination, the child patient was seated either on a chair, on the bed or a parent’s lap. Two dentists took part in the examination process: one dentist examined the child’s mouth while the other recorded the findings. The patient’s name, age, gender, date of examination, cardiac condition and any other relevant medical problem were recorded in an especially designed chart (Fig. 1).

Fig. 1: A specially designed chart was used to record the relevant information of each examined child with congenital heart disease.

A successive identification code number was provided for each child. The Intraoral examination was carried out visually for every child using a pen torch for an intraoral illumination, and a sterile disposable mouth mirror. Each child was examined separately by both examiners, and the finding was documented in a specially designed chart. Caries experience and gingival health status were assessed for the subjects. The associated medical conditions and relevant times of cardiac surgery were recorded.

Caries experience evaluation

Caries experience was evaluated using the DMT index for the permanent dentition and the dmft index for the primary dentition (14). The teeth were examined clinically by using a pen torch (PAT COAKLEY Surgical LTD) and mouth mirror for visual evidence of decay (d/D), missing teeth due to decay (m/M) and filled teeth (f/F). Teeth were not cleaned before examination unless they were covered by food debris by asking the child to clean his/her own teeth by toothbrushing. Radiographs were not used. Mean ± SD of dmft/DMFT scores for different groups of children were calculated.

Gingival Inflammation evaluation (GE & GS indices)

Probing of the gingiva was as avoided because these children were considered to be at risk of developing infective endocarditis. A number of gingival indices were developed which rely upon bleeding following “gentle probing” as an earlier sign of gingivitis such as the Russell’s periodontal index (15,16,17), sulcular bleeding index (SBI), the papillary bleeding index (PBI), the gingival index (GI) (18) and their modifications (19), as well as the extent & severity index (ESI) (20). However, the value of bleeding as the most sensitive indicator of gingivitis has been questioned, with some authors noticing that in the early gingivitis, changes in color and contour have been observed to precede bleeding on probing (21,22). For that reason, a simple modification of the PMA index was used to assess the prevalence of gingivitis for the present group of patients (23,24,25). Massler et al., (1950) examined the posterior and anterior segments in both arches (24). He stated that a great proportion of the gingivitis observed in any given mouth was confined, for the most part, to the ten anterior teeth (upper and lower) gingival units and he suggested the use of anterior teeth as index teeth without defining which ones to be indexed. The procedure was based on
visually assessing the presence or absence of inflammation in three parts of the gingival tissue:

1. papillary (P): that portion of the gingiva occupying the interdental space between two adjacent teeth.
2. (M) refers to marginal gingiva which forms a collar of free gingiva around the neck of the tooth.
3. (A) stands for attached gingiva which is attached by a dense fibrous tissue to the underlying bone.

The clinical sign of gingivitis includes changes in gingival color (redness), alteration of normal contour (edema), loss of stippling, increased gingival crevicular fluid flow, engorgement, bleeding and in some cases, ulceration (19). The use of the anterior teeth as an index to the gingivitis experience of the entire mouth was suggested but not done by Masl for a number of reasons:

1. It saves time: it is much easier to observe the anterior segments than posterior ones.
2. Greater accuracy, and therefore, uniformity in observations could be achieved.
3. Quantitative: it was more accurate statically to compare the anterior segment of the mouth rather than all of the dentition (24).

The index teeth used were the four upper incisors and six lower anterior teeth from cuspid to cuspid (Figs. 2 & 3).

Table 1: the groups of gingivitis extent scores

<table>
<thead>
<tr>
<th>Four subgroups of Gingivitis Extent score (GE)</th>
<th>The sum of the numbers of all examined areas in both arches</th>
</tr>
</thead>
<tbody>
<tr>
<td>GE1</td>
<td>No gingivitis</td>
</tr>
<tr>
<td>GE2</td>
<td>Score 1-6</td>
</tr>
<tr>
<td>GE3</td>
<td>Score 7-14</td>
</tr>
<tr>
<td>GE4</td>
<td>Score 15-18</td>
</tr>
</tbody>
</table>

Gingivitis severity (GS) scoring system was also used to assess the severity of gingivitis by modifying the PMA index of Masler et al., (1957) (26) (Table 2).
Table 2: A severity score for gingivitis

<table>
<thead>
<tr>
<th>Gingivitis score (GS)</th>
<th>The Characteristic features</th>
</tr>
</thead>
<tbody>
<tr>
<td>GS = 0</td>
<td>No gingivitis characterised by colour-pale pink: texture-firm, no spontaneous or on firm digital pressure bleeding.</td>
</tr>
<tr>
<td>GS = 1</td>
<td>Mild gingivitis with slight change in colour and little loss of contour.</td>
</tr>
<tr>
<td>GS = 2</td>
<td>Moderate gingivitis with swelling, glazing and redness. Papillae or margins blunted or rounded.</td>
</tr>
<tr>
<td>GS = 3</td>
<td>Severe gingivitis with more swelling, redness and spontaneous bleeding. Slight ulceration.</td>
</tr>
<tr>
<td>GS = 4</td>
<td>Very severe more than above including sloughing and ulceration.</td>
</tr>
</tbody>
</table>

It was based on visual appearance, and severity of inflammation was graded numerically in successive degrees according to increasing intensity and extent.

3. RESULTS

Seventy children with different forms of congenital heart disease were examined; 29 girls and 41 boys. The study sample was divided into three age groups were formulated: <6 years old; 6-12 years old and >12 years old (Fig. 4).

Fig. 4 shows the distribution of our child sample into 3 groups based on age

Diagnosis of congenital cardiac defects and the associated medical problems

The diagnoses of the cardiac conditions were: Tetralogy of Fallot (TOF): 6 children (3 unrepaired and 3 repaired); transposition of greater arteries (TGA): 1 child; Atero-ventricular septal defect (AVSC): 4; tricuspid atresia: 3; ventricular septal defect (VSD): 25; VSD with other defects: 10; atrial septal defect (ASD) alone: 1, and with other defects: 7; pulmonary stenosis: 3 (one isolated and two with other defects); coarctation of aorta: 2; patent ductus arteriosus: 5; Down syndrome: 6; Marfan syndrome: 1; Pacemaker: 1; William disease: 2. Three cases had recent infective endocarditis with bacteremia without previous history of dental procedures, and the cultured organism was Staphylococcus aureus. In this sample, boys tend to have a significant increase in complex heart disease (more than one form of CHD) than girls (29 to 17, respectively). Cyanosis was evident clinically and recorded in the medical notes at the time of examination in 5 cases (4 boys and 1 girl). Associated medical histories were 6 cases with Down’s syndrome, 1 case of epilepsy, 3 cases had a fever due to infective endocarditis, 2 cases of anemia and 2 cases of William disease.

Periodontal health status

Periodontal health status as recorded by our GE and GS indices revealed that there was a significant level of gingival inflammation in all age groups (p<0.0001). Healthy gingival (GE1) were found in 4 (6%) out of 70, and the majority of them 66 belonged to GE2 (28 children); 25 cases had GE3 and 13 with GE4 (Table 3). Gingivitis severity scores (GS) also showed a tendency for all the groups to have more gingivitis (Table 4).
Table 3: Gingivitis Extent (GE) subgroups and age groups

<table>
<thead>
<tr>
<th>Gingivitis Extent (GE) subgroups</th>
<th>Age groups</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 6 years</td>
<td>6-12 years</td>
<td>&gt; 12 years</td>
</tr>
<tr>
<td>GE 1 (0)</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>GE 2 (1-6)</td>
<td>14</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>GE 3 (7-14)</td>
<td>10</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>GE 4 (15-18)</td>
<td>2</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>29</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 4: The distribution of gingivitis severity (GS) scores in both upper and lower index teeth for the 4 GE subgroups.

<table>
<thead>
<tr>
<th>Gingivitis Severity (GS) subgroups</th>
<th>Age groups</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 6 years</td>
<td>6-12 years</td>
<td>&gt; 12 years</td>
</tr>
<tr>
<td>No gingivitis = GS (0)</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Mild gingivitis = GS (1)</td>
<td>8</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Moderate gingivitis = GS (2)</td>
<td>16</td>
<td>17</td>
<td>8</td>
</tr>
<tr>
<td>Severe gingivitis = GS (3)</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>29</td>
<td>12</td>
</tr>
</tbody>
</table>

The data showed that 4% of the children were gingivitis-free as defined by a GS=0, whereas 20 children had mild gingivitis (GS1), the majority, 40 cases, had moderate gingivitis (GS2) while severe gingivitis was present in 5 children. There was no significant relation (p>0.05) between age groups of boys and girls according to GE and GS scores upon the application of the paired samples statistics analysis using SPSS (20).

Caries experience

In this sample, 49% of 70 children with CHD have untreated caries. Total caries experience in relation to different age groups as was 1.17 ± 2.6 in < 6 years old children; 3.81±4.18 in 6-12 years old and 0.29±1.29 in > 12 years old (Fig. 5). Untreated caries were present in 7 of 29 (24%) in < 6 years old; 22 of 29 (76%) in 6-12 years old; and 5 of 12 (42%) in >12 years old (Fig. 6).
Fig. 5: shows total caries (dt+DT) in all age groups in which greater caries extent, found among mixed dentition children (3.81), was compared to other groups.

Fig. 6: shows untreated caries in deciduous teeth (dt)
Twenty-six children had a dmft score ranging from 1 to 14 and ten of the children had DMFT within the study group. Eight children out of 29 in 6-12 years old had no evidence of caries (teeth from both dentitions included), whereas only 7 of the >12 children had no caries experience. There was no significant difference in total caries experience (DMFT & dmft) between boys and girls. Six children who underwent cardiac surgery in the past presented with multiple decayed teeth (dt/DT).

Only one child had filled tooth in >12 years old group with (FT=1), whereas, missing teeth (mt) due to caries were seen in primary teeth in 7 children and one child in >12 years had two missing teeth (MT=2).

4. DISCUSSION

This was the first study to investigate the oral health status of a group of in-patient children with congenital disease among Libyan children with CHD. Assessing the periodontal health status was done using the novel GE index as a simplified modification of the PMA index (24) to allow the simple enumeration of inflamed units, irrespective of severity, for the anterior maxillary and mandibular segments. It was first performed previously by the same principle author, in her master thesis, on Irish children with congenital heart disease in 1996. Despite being stated in 1950 by Massler et al. (24), they did not define which anterior teeth to be used for the index in that such an abbreviation of the original full mouth index may be useful, as it saves time and gives more accuracy since the anterior segments are easier to examine than the posterior units. In addition to GE index, a further examination was done to assess the severity of gingival inflammation, and this was called gingivitis severity (GS) index, whereby a score was assigned to the most inflamed part unit. Owing to the debilitated and sometimes anxious state of the subjects, such indices were used in the present study because they were expedient and non-invasive. In one study, it was found that transient bacteremia was induced by toothbrushing in 96 healthy subjects with varying degrees of gingival inflammation; therefore both the degree and extent of gingivitis were assessed (11).

Although the indices used did not include registration of gingival bleeding, changes in color and contour have been observed to precede bleeding on probing (21,22). GE was divided into 4 subgroups for ease of description and analysis. In one study of healthy children, an increased level of gingivitis was noticed in older children compared to younger ones (24). The younger children with deciduous teeth may respond to bacterial accumulation with less gingivitis than older children with permanent teeth (27). It was found 52% of 12 years old and 57% of 15 years old demonstrated gingivitis (28). However, these results in healthy children are not directly comparable to the results of the present study as probing was not indicated for the CHD children. Interestingly, we noticed a significant increase in caries experience using the guidelines of Palmer et al. (1984) in both dentitions. However, the present study was carried out in hospitalized children who were often distressed and of varying youth ages; making the recording of such an index difficult, if not impossible. The patients in the present study were examined either on the bed, on an ordinary chair or the parent’s lap. Hallett et al. (1992) found that children with CHD suffer from poorer oral hygiene compared to control siblings, which was particularly evident in the primary dentition, whereas the differences in the permanent dentition were less pronounced, perhaps because the number of children with permanent teeth in that study was low (29). These findings may arise because of abnormal feeding patterns such as prolonged nursing beyond one year and lack of daily toothbrushing. However, this strategy must be seriously questioned for that risk, as bacteremia may result from such infected foci, regardless of the limited time they would remain in the mouth. The finding of the present study is in agreement with a previous study on 100 children with cardiac conditions (30), where they used the same criteria for caries experience as used for our study. They found that 68% of the youngest age group (2-4 years old) were free of caries and that the caries experience of the 5-9 years old was significantly higher. However, it must be noticed that the low caries rate in the youngest age group may partly be due to incompletely erupted deciduous dentition as 15 of the 29 children in the > 6 years old children were under the age of 2.5. Interestingly, Fleming & Kinirons (31) used the same dmft/DMFT index and found essentially similar trends in a group of 52 children in the remission stage of acute lymphoblastic leukemia into three age groups to those recorded for the present study. In the present study, there were 15 children who had undergone cardiac surgery before the examination. Such patients were considered highly susceptible to serious complications from transitory bacteremia (32). Gingivitis was noted in all of the children who were operated at any time previously. The presence of untreated caries and gingivitis in those at risk children is expected since oral hygiene procedures may not be considered.
important as critical care measures associated with the immediate postoperative phase of care. These findings clearly emphasize the need for elimination of oral foci of infection before any heart operation, which may place the patient’s health at risk. In our sample, cyanosis was present in 6 of the subjects examined, and there was more untreated caries and moderate to severe gingivitis in those children. In contrast, Berger reported increased caries experience in such children. Some cases had an immune deficiency which leads to lowering the tolerance to infection (33). In the present study, children with cyanosis tended to have more caries and gingivitis with one child, aged 7, had 10 carious teeth and severe degree of gingivitis with GE 4. Three subjects in the present study had been under antibiotic treatment for infective endocarditis. These patients had complex CHD, and two of them had undergone cardiac surgery, but neither had received a dental procedure which would have precipitated the attack. One of the patients had 13 inflamed gingival sites. The main organism implicated was Staphylococcus aureus which, upon poor plaque control in patients with low T-cells, may lead to increased severity of periodontal disease (33), as there is a shift in the flora from gram-positive to gram-negative rods (34). Mild trauma due to mastication or tooth brushing can cause a transient bacteremia from the mouth (35,36,37). In an Irish study (the same principal author), decay was seen to be higher in the mixed dentition (6-12 years old), in whom 11 of 30 children had decayed teeth compared to one child of 48 in the < 6 years old, and 6 of 23 children in > 12 years old (38). The values for gingival inflammation using the same indices (GE & GS) were 16% of the youngest (38), and whereas five (7%) cases were seen in the older age group. Lack of professional dental consultation.

6. RECOMMENDATIONS

1) It is important these patients be targeted for prevention from oral infectious foci to minimize the potentially pathogenic microenvironment as well as preventive decay.
2) Consultations regarding oral health before any open heart surgery.

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REFERENCES


9. Gunteroth WG. How important are dental procedures as a cause of infective endocarditis? The American Journal of Cardiology. 1984;54(7):797-801.